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DIVISION 16 - ELECTRICAL

SECTION 16275J

OVERHEAD MOUNTED TRANSFORMERS

02/05

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OVERHEAD MOUNTED TRANSFORMERS
02/05

NOTE:
This section covers single- and three-phase overhead
mounted dry-type and oil-insulated transformers.
Drawings should indicate size, type, and
installation details.

PART 1 GENERAL

1.1 REFERENCES

NOTE: The following references should not be
manually edited except to add new references.
References not used in the text will automatically
be deleted from this section of the project
specification.

The publications listed below form a part of this section to the extent
referenced:

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C37.47	(2000) For High Voltage Current-Limiting Type Distribution Class Fuses and Fuse Disconnecting Switches
ANSI C57.12.20	(1988) Overhead-Type Distribution Transformers, 500 kVA and Smaller: High-Voltage, 34,500 Volts and Below; Low Voltage, 7970/13,200 Y Volts and Below
ANSI C57.12.27	(1982) Conformance Requirements for Liquid-Filled Distribution Transformers Used in Pad-Mounted Installations, Including Unit Substations
ANSI C57.12.28	(1999) Pad-Mounted Equipment - Enclosure Integrity
ANSI C57.12.29	(1991) Pad-Mounted Equipment - Enclosure Integrity for Coastal Environments
ANSI C62.11	(1999) Standard for Metal-Oxide Surge Arresters for Alternating Current Power Circuits

ASTM INTERNATIONAL (ASTM)

ASTM D 877 (2000) Standard Test Method for Dielectric Breakdown Voltage of Insulating Liquids Using Disk Electrodes

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 386 (1995;R 2001) Standard for Separable Insulated Connector Systems for Power Distribution Systems Above 600V

IEEE C57.12.00 (2000) Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers (ANSI/IEEE)

IEEE C57.12.25 (1992) Standard for Pad-Mounted, Compartmental-Type, Self-Cooled, Single-Phase Distribution Transformers with Separable Insulated High-Voltage Connectors (34 500-Grd Y/19 920 Volts and Below; Low Voltage, 240/120; 167 kVA and Smaller)

IEEE C57.12.26 (1992) Transformers - Pad-Mounted Compartmental-Type, Self-Cooled, Three-Phase Distribution Transformers for Use with Separable Insulated High-Voltage Connectors, High Voltage, (34,500 Grd Y/19, 920 and Below; 2500 kVA and Smaller)

IEEE C57.12.80 (2002) Standard Terminology for Power and Distribution Transformers

IEEE C57.12.90 (1999) Standard Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers (ANSI/IEEE)

IEEE C62.11 (1999) Standard for Metal-Oxide Surge Arresters for Alternating Current Power Circuits

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ST 1 (1988) Specialty Transformers (Except General Purpose Type)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2002) National Electrical Code

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FED-STD 595 (Rev B) Colors Used in Government Procurement

UNDERWRITERS LABORATORIES (UL)

UL 506 (2002) Specialty Transformers

1.2 GENERAL REQUIREMENTS

NOTE: If Section 16003, "General Electrical Provisions," is not included in the project specification, applicable requirements therefrom should be inserted and the following paragraph deleted.

NASA Section 16003, "General Electrical Provisions," applies to work specified in this section.

Certification of previous tests on similar units under actual conditions may be submitted for impulse tests, temperature rise tests, sound tests, power-factor tests, bushing tests, and short-circuit tests in lieu of factory tests on actual units furnished.

Equipment and performance data shall be submitted for distribution transformers including resistance measurements, impedance, and voltage and load losses at rated currents.

Equipment foundation data for distribution transformers shall include plan dimensions of foundations and relative elevations, equipment weight and operating loads, horizontal and vertical loads, horizontal and vertical clearances for installation, and size and location of anchor bolts.

1.3 SUBMITTALS

NOTE: Review submittal description (SD) definitions in Section 01330, "Submittals," and edit the following list to reflect only the submittals required for the project. Submittals should be kept to the minimum required for adequate quality control. Include a columnar list of appropriate products and tests beneath each submittal description.

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-03 Product Data

Equipment and Performance data and Equipment Foundation Data shall be submitted for distribution transformers.

Manufacturer's Catalog Data shall be submitted for the following items:

Distribution Pad-Mounted Transformers
Dry-Type Transformer

SD-06 Test Reports

Test reports shall be submitted for the following tests on

distribution transformers in accordance with the paragraph entitled, "Field Testing," of this section.

Insulating Liquid Tests
Power Factor Tests
Insulation Resistance Tests
Insulation Power Factor (Doble) Tests

SD-07 Certificates

Certification of previous tests on similar units under actual conditions may be submitted for impulse tests, temperature-rise tests, sound tests, power-factor tests, bushing tests, and short-circuit tests in lieu of factory tests on actual units furnished.

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals shall be submitted for the following equipment:

Dry-Type Distribution Transformers
Pad-Mounted Liquid-Filled Distribution Transformers

1.4 QUALIFICATION TESTING

Tests on transformers shall comprise the manufacturer's standard tests including resistance measurements of all windings; ratio tests; polarity and phase-relation tests; no-load loss at rated voltage; impedance; voltage and load loss at rated current; insulation power factor (Doble) tests, insulation oil tests, and dielectric tests. Comply with the applicable sections of ANSI C57.12.20. For oil-filled units manufacturer shall certify that the oil contains no PCB's and shall affix a label to that effect on the transformer tank and on each oil drum containing the insulating oil. Submit Certification of previous tests on similar units under actual conditions.

1.5 DRAWINGS

Connection diagrams shall be submitted for distribution transformers indicating the relations and connections of devices and apparatus by showing the general physical layout of all controls, the interconnection of one system or portion of system with another, and internal tubing, wiring, and other devices. Submit with Manufacturer's Catalog Data, including Distribution Pad-Mounted Transformers and Dry-Type Transformer.

Fabrication drawings shall be submitted for distribution transformers consisting of fabrication and assembly details to be performed in the factory.

Installation drawings shall be submitted for distribution transformers in accordance with the paragraph entitled, "Installation," of this section.

PART 2 PRODUCTS

2.1 EQUIPMENT STANDARDS

2.1.1 Pad-Mounted Liquid-Filled Dead Front, Loop Feed Distribution Transformers

Pad-mounted liquid-filled distribution transformers with primary connections to underground high-voltage lines and secondary connections to underground low-voltage distribution feeder circuits shall be two-winding, three-phase, as indicated, 60-hertz, oil-immersed, 65-degree C rise, self-cooled, Class OA, outdoor type, conforming to ANSI C57.12.27, IEEE C57.12.25, IEEE C57.12.26, IEEE C57.12.80, and IEEE C57.12.90. Primary windings of three-phase pad-mounted transformers shall be delta/wye connected. Winding shall be aluminum or copper. Submit Equipment and Performance data, Equipment Foundation Data, and Manufacturer's Catalog Data.

2.1.2 High Voltage

High-voltage compartment shall contain the incoming line, insulated high-voltage load-break connectors, bushing well inserts, six high-voltage bushing wells, surge arresters per IEEE C62.11, access to oil-immersed fuses, bayonet with ELSP fuses, 4 positions "T" blade LBOR, tap changer handle, connector parking stands with insulated standoff bushings, protective caps, and ground bus.

- a. Insulated high-voltage load-break connectors: IEEE 386, rated 15kV, 95 kV BIL. Current rating: 200 amperes rms continuous. Short time rating: 10,000 amperes rms symmetrical for a time duration of 0.17 seconds. Connector shall have a steel reinforced hook-stick eye, grounding eye, test point, and arc-quenching contact material.

- b. Provide bayonet oil-immersed, expulsion fuses in series with oil-immersed, current-limiting fuses. Coordinate protection with expulsion fuse clearing low-current faults and current-limiting fuse clearing high-current faults.

Oil-immersed current-limiting fuses: ANSI C37.47; 150 kV BIL; 50,000 amperes symmetrical interrupting rating.

- c. Surge arresters: ANSI C62.11, rated 10kV, fully shielded, dead-front, metal-oxide-varister, elbow type with resistance-graded gap, suitable for plugging into bushing well inserts. Provide three arresters for radial feed circuits.

2.1.3 High Voltage, Dead-Front

High-voltage compartment shall contain the incoming line, six high-voltage bushing wells configured for loop feed application, access to oil-immersed fuses, tap changer and load break switch handle, connector parking stands with protective caps and ground pad.

NOTE: The following paragraph is based on 200-ampere connectors. If transformer primary load current is greater than 200 amperes or if primary cable size is greater than No. 4/0 AWG, designer shall determine the appropriate connector system.

Loop Feed Sectionalize Switches: Provide three, two-position, oil-immersed type switches to permit closed transition loop feed and sectionalizing. Each switch shall be rated at 15 kV, 95 kV BIL, with a continuous current rating and load-break rating of 200 amperes, and a make-and-latch rating of 10,000 rms amperes symmetrical. Locate the switch handles in the high-voltage compartment. Operation of switches shall be as follows:

ARRANGE- MENT NO.	DESCRIPTION OF SWITCH ARRANGEMENT	SWITCH POSITION					
		LINE A SW.		LINE B SW		XFMR. SW	
		OPEN	CLOSE	OPEN	CLOSE	OPEN	CLOSE
1	Line A connected to Line B and both lines connected to transformer		X		X		X
2	Transformer connected to Line A only		X	X			X
3	Transformer connected to Line B only	X			X		X
4	Transformer open and loop closed		X		X	X	
5	Transformer open and loop open	X		X		X	

Provide bayonet oil-immersed, expulsion fuses in series with oil-immersed, partial-range, current-limiting fuses. Bayonet fuse links shall sense both high currents and high oil temperature in order to provide thermal protection to the transformer. Coordinate transformer protection with expulsion fuse clearing low-current faults and current-limiting fuse clearing high-current faults beyond the interrupting rating of the expulsion fuse. In order to eliminate or minimize oil spills, the bayonet fuse assembly shall include an oil retention valve inside the housing which closes when the fuse holder is removed and an external drip shield. Warning shall be conspicuously displayed within the high-voltage compartment cautioning against removing or inserting fuses unless the load-break switch is in the open position and the tank pressure has been released.

Fuse Assembly: 150 kV BIL

Oil-Immersed Current-Limiting Fuses: ANSI C37.47; 50,000 rms amperes symmetrical interrupting rating at the system voltage specified.

Protective Caps: IEEE 386, 200 amperes, 15 kV Class. provide insulated protective caps (not shipping caps) for insulating and sealing out moisture

from unused bushing well inserts.

2.1.4 Low Voltage

Low-voltage compartment shall contain low-voltage bushings with NEMA spade terminals to house CT's and service lugs, accessories, stainless steel diagrammatic transformer nameplate, and ground bus.

- a. Accessories shall include drain valve with sampler device, fill plug, pressure relief device, liquid level gage, pressure-vacuum gage, and dial type thermometer with maximum temperature indicator.
- b. The low-voltage bushings shall be molded epoxy, and provided with 8-hole blade-type space terminals with NEMA standard hole spacing arranged for vertical take-off. The low voltage neutral shall be an insulated bushing, grounded to the tank by a removable bonding jumper. Submit Equipment and Performance data

2.1.5 Transformer

- a. Oil-insulated, two winding, 60 hertz, 65 degrees C rise above a 30 degrees C average ambient, self-cooled type.
- b. Transformer shall be rated as indicated, 95 kV BIL.
- c. Transformer voltage ratings:
 - Primary 13.2 kV
 - secondary as indicated.
- d. Entire transformer (tank, base and cabinet) shall be stainless steel, type 304. Welding rods shall be 304L. All tank fittings (nipples, couplings and plugs) shall be stainless steel. All hardware, gunstuds and mounting plates shall be stainless steel. Radiator's and lifting lugs shall be stainless steel. The top cover shall be welded. Fastenings shall be tamper proof. The transformer shall remain effectively sealed for a top oil temperature range of -30 C to 105 C. When required cooling panels will be provided on the back and the sides of the tank. Lifting eyes and packaging pads will be provided. Transformer shall conform to ANSI c57.12.28.
- e. Tap changer shall be externally operated, manual type for changing tap setting when the transformer is de-energized. Provide four 2.5 percent full capacity taps, two above and two below rated primary voltage. Tap changers shall clearly indicate which tap setting is in use.
- f. Minimum tested impedance shall not be less than 5.75 percent.
- g. Audible sound levels shall comply with the following:

<u>kVA</u>	<u>DECIBELS (MAX)</u>
75	51
112.5	55
150	55
225	55
300	55
500	56

<u>kVA</u>	<u>DECIBELS (MAX)</u>
750	57
1000	58
1500	60

- h. Transformer shall include lifting lugs and provisions for jacking under base. The transformer base construction shall be of the fabricated type and suitable for using rollers or skidding in any direction. Provide transformer top with an access handhole. Transformer shall have its kVA rating conspicuously displayed on its enclosure and comply with ANSI C57.12.28. The transformer shall have an insulated low-voltage neutral bushing with lugs for ground cable, and with removable ground strap.

2.1.6 Insulating Fluid

Transformers shall be designed in accordance with the requirements of IEEE C57.12.00 and labeled by Factory Mutual Research Corporation as meeting the requirements of Approval Standard 3990, insulated with less-flammable fluid all in compliance with the current NFPA 70.

2.1.7 EQUIPMENT FINISH

Transformers shall be provided with the frame, base, and tank made of Type 304 stainless steel.

The transformers shall have the manufacturer's standard finish for highly corrosive areas. The finish shall meet the requirements of ANSI C57.12.29 and must be No. 7GY3.29/1.5 Munsell Green in accordance with FED-STD 595.

2.1.8 SEPARABLE CONNECTORS

Shall conform to IEEE 386 rated 95 kV BIL for operation on 13.2kV, 3-phase, 4-wire grounded system. Bushings rated for continuous current of 200 amperes (loadbreak) and a momentary short time symmetrical rating of 10,000 RMS amperes for 0.17 seconds.

2.2 Dry-Type Distribution Transformers

General-purpose dry-type transformers for connection to low-voltage distribution circuits of 600 volts or less and the supply of current for lighting and power loads shall be two-winding, 60-hertz, self-contained, self-cooled, Class AA in accordance with NEMA ST 1 and UL 506.

Insulation system limiting temperature shall be in accordance with the following table, with a temperature rise of:

<u>Dry-Type Class</u>	<u>Maximum Rise by Resistance</u>	<u>Reference Temperature</u>
A	55 degrees C	75 degrees C
B	80 degrees C	110 degrees C
F	115 degrees C	135 degrees C
H	150 degrees C	180 degrees C

PART 3 EXECUTION

3.1 INSTALLATION

Pad-mounted distribution transformers shall be installed and secured on concrete pads and shall be grounded to a ground grid.

Each pad-mounted distribution and dry type transformer shall have its kVA rating conspicuously displayed in 3-inch 75 millimeter high yellow letters on its tank or enclosure in addition to the complete manufacturer's standard identification plate.

Dry type transformers shall be installed on resilient vibration-isolating mountings and connected with flexible metallic conduit to prevent transmission and amplification of sound.

3.2 FIELD TESTING

3.2.1 Insulating Liquid Dielectric Test

Transformers filled with non-PCB insulation liquid shall have the insulating liquid dielectrically tested after installation and before being energized. Insulating liquid shall be tested per Insulating Liquid Tests in accordance with ASTM D 877, and breakdown voltage shall be not less than 25,000 volts.

3.2.2 Insulation-Resistance Tests

Transformer windings shall be given an insulation-resistance test per Insulation Resistance Tests, Insulation Power Factor (Doble) Tests, using the following test set versus voltage level criteria:

Dry type 480 to 600 volts transformers - 1,000 volt test

Liquid type 15-to 5-kilovolt transformers - 2,500-volt test set
(primary)

Tests shall be applied for not less than 5 minutes and until three equal consecutive readings, 1 minute apart, are obtained. Readings shall be recorded every 30 seconds during the first 2 minutes and every minute thereafter. Minimum acceptable resistance shall be 100 megohms for pad transformers only.

Readings shall be recorded every 15 seconds for the first minute and every minute thereafter for 10 minutes. Resistance between phase conductors and ground shall be no less than the following:

Liquid type 5 to 15 KV	125 megaohms
Dry type below 600 volts	200 megaohms

3.2.3 Insulation Power Factor (Doable) Tests

Transformer windings shall be given an insulation power factor test per Power Factor Tests and winding excitation test in accordance with ANSI IEEE C57.12.90. Insulation power factor shall not exceed 0.5 percent for new liquid filled units. New dry type units can have power factors up to 5.0 percent and still be acceptable.

3.2.4 Acceptance

Final acceptance shall depend upon the successful performance of the equipment under test. Transformers shall not be energized until recorded test data have been approved by the Contracting Officer. Submit Operation and Maintenance Manuals for the following equipment:

Dry-Type Distribution Transformers

Pad-Mounted Liquid-Filled Distribution Transformers

-- End of Section --